AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 40:502–511 (2001)

Comparison of a Traditional Questionnaire With an Icon/Calendar-Based Questionnaire to Assess Occupational History

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Background *Self-reported work histories are an essential tool for estimating exposure in many occupational epidemiologic studies. However, the transience of some occupations such as farm work can hamper recall, resulting in inaccurate reporting. To address this problem, we have developed an icon/calendar-based questionnaire. This study compares work histories collected via this questionnaire to those collected via a traditional questionnaire.*

Methods *Eighty-nine farmworkers and non-farmworkers were interviewed twice, 8–10 months apart, about their lifetime employment. In the first interview, subjects were asked to recount their entire work history, starting from the interview date and moving backwards in time ("traditional questionnaire"). In the second interview, subjects were first asked about important life events, which were recorded with icons on a calendar. They were then asked to recount their work history, which was recorded, job-by-job, on the calendar with icons ("icon-calendar questionnaire").*

Results *Number of jobs and amount of work time accounted for since first employment were significantly greater using the icon-calendar questionnaire than the traditional questionnaire, the disparity increasing with time from the date of interview. The ratio of number of jobs in the traditional questionnaire to number of jobs in the icon-calendar questionnaire decreased from 100.0% in the most recent time period to 0.0% in the earliest time period. While the percentage of time explained by employment remained relatively constant across time periods in the icon-calendar questionnaire, ranging from 86.3 to 98.9%, it rapidly decreased with time in the traditional questionnaire, from 77.9% in the most recent time period to 0.0% in the earliest time period.*

Conclusions *The icon-calendar questionnaire was more effective than the traditional questionnaire for obtaining complex work histories during interviews, producing a more complete picture of a person's work history.* Am. J. Ind. Med. 40:502–511, 2001. *Published 2001 Wiley-Liss, Inc.*†

KEY WORDS: icon; calendar; questionnaire; occupational history; recall; memory aids

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Contract grant sponsor: National Cancer Institute; Contract grant number: QTR50104; Contract grant sponsor: National Institute for Environmental Health Sciences Training; Contract grant number: ES07262; Contract grant sponsor: National Institute for Occupational Safety and Health (NIOSH) SERCA; Contract grant number: 3-K01OH00133-03S1; Contract grant sponsor: NIOSH-supported PNASH; Contract grant number: U07/CCU012926-02; Contract grant sponsor: Worker's Compensation Fund of the State of Washington administered by the Washington State Department of Labor and Industries.

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Accepted 9 April 2001

INTRODUCTION

Work histories are an essential part of many occupational epidemiologic studies. While worker personnel records are the most common means of assessing work history [Checkoway et al., 1989], these records may not exist or may be unavailable for transient occupations such as farm work. In such situations, self-reported work histories are often the only means of estimating exposure. However, this transience—which often results in a worker having several employers and a wide variety of tasks each year—can hamper recall, resulting in inaccurate reporting of exposure history. This is especially likely if the subject is asked to recall employment over a prolonged period of time [Checkoway et al., 1989]. Research in cognitive psychology and questionnaire design suggests that this is due in part to the fact that the date of an ''event'' is usually one of its least-remembered attributes, necessitating the use of ''landmarks'' or better-remembered aspects of the event in order to recall its timing [Strube, 1987; Sudman, 1989; Brewer, 1994; Warnecke et al., 1997].

Similar problems of recall arise in epidemiologic studies of other variable, prolonged exposures. Memory aids have been adopted by researchers in some of these studies in order to facilitate subject recall. In particular, several studies involving oral contraceptive use history have utilized calendars on which were recorded a subject's major life events around which contraceptive use might be more accurately recalled [Centers for Disease Control, 1983; Stadel et al., 1985; Centers for Disease Control and National Institute of Child Health and Human Development, 1986; van Leeuwen et al., 1992; White et al., 1994]. A case-control study of sun exposure and skin cancer in Australia used calendars in which subjects recorded their residential and work histories for each year of life. Interviewers then used these calendars as the basis for questions concerning personal sun exposure during outdoor activities [Kricker et al., 1993].

The present study compares work histories collected using a visually integrated system of memory aids with those collected via a traditional questionnaire for a group of farm workers and non-farm workers. These memory aids consist of: (1) a life events calendar similar to those used in some studies of oral contraceptive use, and (2) icons representing various life events and jobs. The former provides chronological ''anchors'' around which a subject might more easily recall his or her work history. The latter, consisting of small toys and knickknacks such as cars, flags, babies, fruits, and animals, enables the interviewer to build a readily interpretable pictorial representation of a subject's life/work history, especially useful for illiterate or semi-literate subjects (see Fig. 1). These two memory aids together comprise what we refer to as the ''icon-calendar questionnaire.''

This study grew out of a larger follow-up study of neurological function among farm workers. In the parent study, subjects were asked to provide detailed lifetime occupational histories in order to determine cumulative lifetime pesticide exposures. It became apparent during the first round of that study that the work history of a typical farm worker was too complex—in terms of number of jobs, number of employers, and work locations in a given year and over a lifetime—to capture via traditional questionnaire methods. Subjects were often unable to adequately recount their occupational histories because of difficulties remembering not only what jobs they had performed in a given year but also what jobs they had already listed for the interviewer. The illiteracy or semi-literacy of most of these subjects limited the usefulness of written cues.

This need for a more appropriate data collection tool led to the development of the icon-calendar questionnaire for the second round of the parent study. The parent study was not originally intended to compare these data collection instruments. As a result, certain design decisions in that study limited the questionnaire analyses which could be performed. In particular, the present study is not an attempt to measure the validity or reliability of the icon-calendar questionnaire; rather, it is a comparison of the quantity and completeness of data captured by the icon-calendar questionnaire vs. the traditional questionnaire. Reliability of the icon-calendar questionnaire has been investigated separately and is reported in an accompanying paper. In addition, there was no questionnaire crossover; all subjects were interviewed with the traditional questionnaire in the first round and with the icon-calendar questionnaire in the second round. In short, this study examines whether data obtained via the icon-calendar questionnaire allows for a more complete and detailed reconstruction of a person's work history than that obtained via a traditional questionnaire.

MATERIALS AND METHODS

Data for this study came from a larger cross-sectional follow-up investigation of neurophysiological function among apple thinners (exposed) and non-apple thinners (reference). Details of subject recruitment are presented elsewhere [Engel et al., 1998]. Briefly, subjects were volunteers recruited from the Wenatchee area (Douglas and Chelan Counties) in central Washington State during July and August, 1994 (Round 1) with follow-up in March–May, 1995 (Round 2). Participation was restricted to persons 16–45 years of age. Exclusion criteria included: having mixed, loaded, or applied pesticides during the preceding 6 months; any self-reported previous pesticide poisonings; and history of diabetes, epilepsy, or meningitis. All subjects were currently or recently employed. The apple thinners were recruited from orchards or worker camps while the non-apple thinners were recruited from local sewing

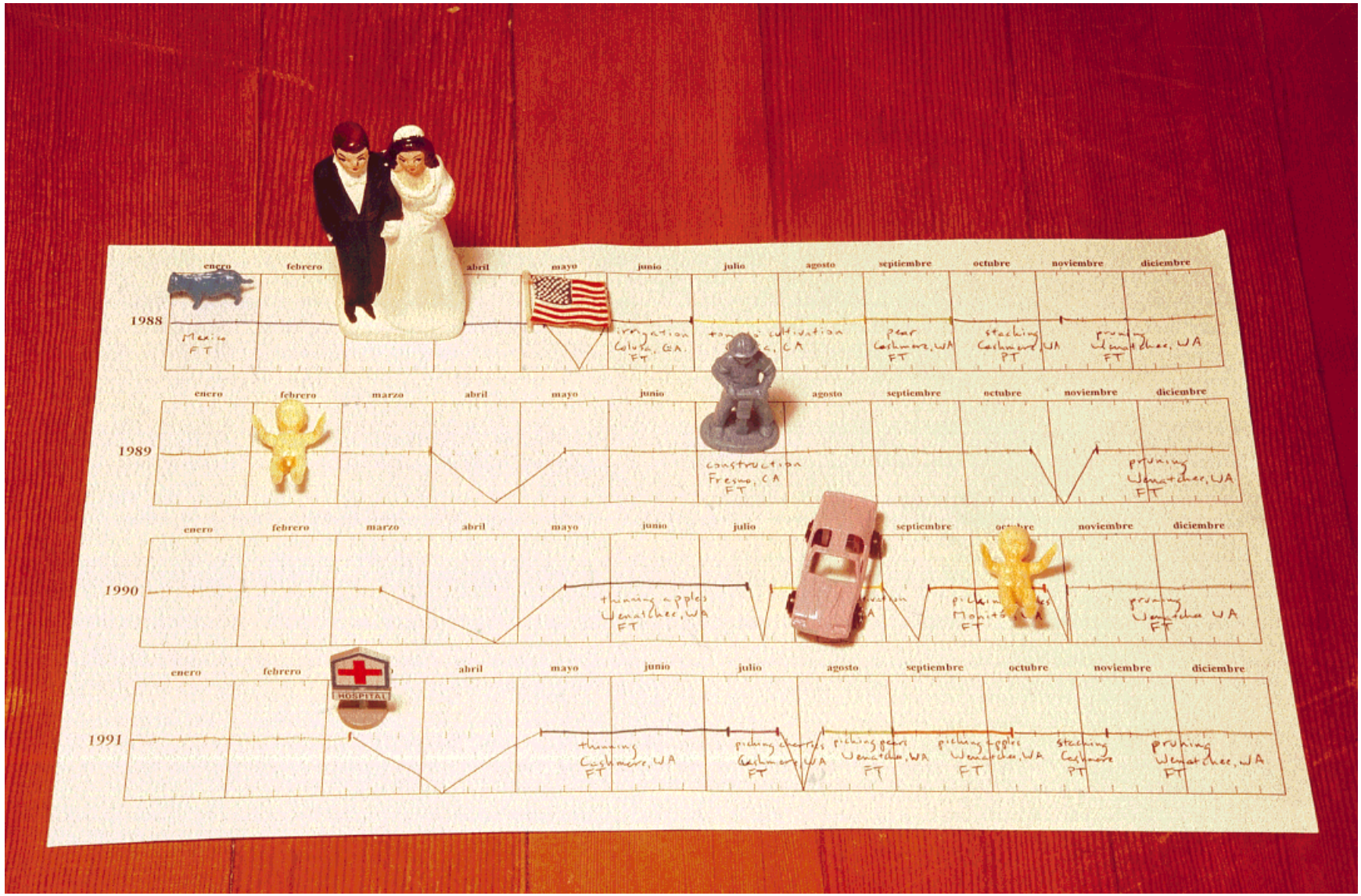

FIGURE 1. Section of a completed life events calendar.

factories, food processors, fruit packing houses, recreational areas (e.g., golf courses, ski resorts), restaurants, and bakeries. Recruitment, examination, and interview were conducted in Spanish. Informed consent was obtained from all participants (or from a parent or guardian of minors). The study protocol was approved by the University of Washington Human Subjects Committee.

All subjects in Round 1 were asked to provide an address and phone number where they expected to be the following spring and also the address and phone number of a contact person. Follow-up of all subjects was attempted the following spring. For all subjects not reachable at the address or phone number provided in Round 1, the contact person was approached for information concerning the subject. If this failed, inquiries were made of fellow study participants who were known to be co-workers or friends of the subject in Round 1.

Forty-six subjects interviewed in the first season either did not participate in the second round of interviews or did not provide a work history. Most of these ($n = 39$; 84.8%) had moved and either could not be located or were no longer in the area and could not be interviewed. Six (4.4%) refused to participate in the second round. Work history was not taken on one subject (0.7%) due to lack of time. The remaining 89 subjects, including both exposed and reference subjects, were included in the present study.

In both Rounds, work histories were collected in an office with minimal distractions via interviewer-administered questionnaire. Two interviewers were used in Round 1; only one of these was used in Round 2. Interviewers were trained to administer the questionnaires and were periodically observed by the researchers during each round.

Both questionnaires, which were initially written in English, were translated into Spanish by the same person. Each questionnaire was translated back into English by another translator in order to verify the initial translation, and any necessary corrections were made.

Traditional Questionnaire

During Round 1, the interviewer sat across from the subject and asked a series of detailed questions concerning all farm work performed in the current season. The subject was then asked to provide detailed work history information—both agricultural and non-agricultural—starting from the present and moving backwards. Information included job titles, activities, dates for each activity, type of crop or product, names and locations of employers, and whether job was full- or part-time. This information was recorded in the questionnaire by the interviewer.

Icon-Calendar Questionnaire

In Round 2, the subject was first asked for the age at which he or she began working. The interviewer sat next to the subject with a ''calendar'' on a table in front of them. The calendar contained rows labeled sequentially with the years between the subject's first reported job and 1995, each marked with the 12 months of the year.

The interviewer asked the subject to provide the month and year of important life events, including the subject's birthdate; when the subject first met their current partner/spouse (if any); marriages; births; deaths; when the subject first came to the United States, to Washington State, and to the Wenatchee area; major injuries or illnesses; and any other events the subject considered important. For each life event, an icon representing the event was placed at the appropriate date on the calendar (Fig. 1).

The subject was then asked a series of detailed questions concerning his or her entire work history—starting from the present and moving backwards—similar to those asked in Round 1. In this interview, although not in Round 1, information on periods of unemployment was solicited and recorded. The interviewer recorded information on the calendar by drawing a line between the starting and ending dates of each job (in 1-week increments), using different colors for different job types (or for unemployment), and by placing on the line an icon representing the job. The interviewer aided the subject's recall by referring to the life event icons previously placed on the calendar to help ''anchor'' the subject in time. For example, if a subject could not remember where he or she was working during the summer of a given year, but had had a child in April of that year, the interviewer might ask ''What were you doing during the summer after this child's birth?''

The process of collecting the subject's work history, using the life event icons and other work history information already recorded on the calendar for context, was continued until the subject had accounted for all time between his first job and the date of interview. Periods that the subject was unable to recall despite the memory aids and interviewer prompting were left blank on the calendar. Upon reaching the first job, the interviewer and subject together reviewed the calendar in case the recalling and recording of other jobs had helped the subject to remember any unexplained periods.

Data Analysis

Analyses comparing both number (count) and duration of jobs in each questionnaire were performed. Work histories were divided into four non-overlapping time periods for analysis: before 1/1/84, 1/1/84–12/31/88, 1/1/89–12/31/93, and 1/1/94–first interview date. Wilcoxon signed ranks test (with a 5% 2-sided level of significance) was used because neither count nor duration data were normally distributed. Data were analyzed with the SPSS for Windows (SPSS Inc., Chicago, Illinois) and S-PLUS for Windows (MathSoft Inc., Cambridge, Massachusetts) statistical programs.

All individual jobs were counted regardless of missing date information. A job was assigned to a period based on the starting and ending dates both being within that period or, if only one date was specified, the period in which that date occurred. If a job spanned more than one period, it was counted separately for each. The ratios of number of jobs reported on the traditional questionnaire to number of jobs reported on the icon-calendar questionnaire were calculated. The sum of all period counts often exceeded the total count since a job which spanned periods was counted once for each period in which it fell but only once for the total. Alternatively, the sum of all period counts sometimes was less than the total count if both starting and ending dates were missing for one or more jobs, in which case those jobs were included in the total count but in none of the period counts.

For the icon-calendar questionnaire, job duration was computed only for those jobs for which the subject reported at least month and year of starting and ending dates. If day was not provided, middle of the month was assumed.

For the traditional questionnaire, job duration was computed only for those jobs for which the subject reported at least starting and ending *years*. Duration was computed in one of two ways: (1) using month and day, when provided; if day was not specified, middle of the month was assumed or (2) using imputed values for starting and/or ending dates (month and day) of a job when subject did not report starting and/or ending months for that job. Starting and ending dates were imputed as the medians of those measures for the particular job among all subjects in the icon-calendar questionnaire. Data from the icon-calendar questionnaire was used for imputation due to the large amount of missing date data in the traditional questionnaire. This cross-questionnaire imputation would tend to make duration estimates from the two questionnaires appear more similar than they really are, resulting in a more conservative analysis of questionnaire differences in this study.

When calculating percentage of period total for a measure of duration (e.g., work or unemployment), the denominator was the number of months in that time period *except* when a subject's work history began within that time period, in which case the denominator was the number of months between the start of the subject's first reported job and the end of that time period. The denominator used for both the icon-calendar questionnaire and the traditional questionnaire was based on information provided in the icon-calendar questionnaire since it consistently provided the most complete time coverage. Total duration of work history was calculated as the number of months between the start of the first reported job and the first interview date.

For the icon-calendar questionnaire, ''missing'' time (i.e., time unaccounted for) in each period was calculated as the difference between the period total and the sum of work and unemployment times. Because unemployment information was not solicited with the traditional questionnaire, ''missing'' time in each period for this questionnaire was calculated as the difference between the period total and the work time, and thus includes periods of unemployment which the subject might otherwise have reported as well as truly unaccounted for time. In comparisons of missing time between the two questionnaires, analyses were performed with this measure in the icon-calendar questionnaire both including and excluding unemployment.

In order to assess differences in quality of data collection between the two interviewers in Round 1, subanalyses using the methods described above were performed for those subjects interviewed by the same interviewer in both rounds. Subanalyses were also performed separately by gender.

RESULTS

Characteristics of Study Subjects

As can be seen in Table I, all 89 subjects in this study were Hispanic. Slightly more than half were male (53.9%)

TABLE I. Selected Characteristics of Study Subjects

Characteristic	N = 89 n (%)
Hispanic	89 (100.0)
Gender	
Female	41 (46.1)
Male	48 (53.9)
Age (years)	
<25	31 (34.8)
25–34	37 (41.6)
≥ 35	21 (23.6)
Years of education	
<5	24 (27.0)
5–9	51 (57.3)
≥ 10	14 (15.7)
Country of education	
Mexico	72 (80.9)
U.S.	2 (2.2)
Both	10 (11.2)
Other	2 (2.2)
None	3 (3.4)
Did any farm work in 1st season[a] prior to 1st interview	53 (59.6)
Did any previous farm work	84 (94.4)
No. months between interviews [mean (SD)]	8.7 (0.8)

[a]1st season defined as 1/1/94 until 8/31/94.

TABLE II. Job and Unemployment Counts in Both Questionnaires

	Number of jobs			Number of unemployment periods[a]
	Median (range)		Median %	Median (range)
Time period	Icon-calendar	Traditional	Traditional / icon-calendar[b]	Icon-calendar
< 1/1/84[c]	5 (1–52)	0 (0–5)[f]	0.0	0 (0–12)
1/1/84–12/31/88[d]	7 (0–34)	2 (0–13)[f]	18.2	1 (0–11)
1/1/89–12/31/93[e]	10 (1–33)	5 (0–18)[f]	50.0	3 (0–15)
1/1/94–interview 1[e]	2 (1–5)	2 (0–9)	100.0	0 (0–2)
Total[e]	23 (3–97)	9 (1–26)[f]	36.5	5 (0–27)

[a]Unemployment information collected only with the icon-calendar questionnaire.
[b]The median ratio of job counts in the traditional questionnaire to the icon-calendar questionnaire, in percent.
[c]Both questionnaires: n = 70.
[d]Both questionnaires: n = 85.
[e]Both questionnaires: n = 89.
[f]$P < 0.001$.

and most were under 35 years of age (76.4%). Most had received 5–9 years of education (57.3%), primarily in Mexico (80.9%). While most had performed farm work during the first season of testing (59.6%), almost all had performed farm work at some time in their lives (94.4%). The mean time between first and second interviews was 8.7 months (standard deviation [SD] = 0.8).

The number of jobs reported by subjects was much higher with the icon-calendar questionnaire than with the traditional questionnaire (Table II). Median total job count reported by subjects was 23 (range: 3–97) using the icon-calendar questionnaire compared to 9 (1–26) with the traditional questionnaire. For each time period except the most recent in a subject's work history, significantly more jobs were reported with the icon-calendar questionnaire than with the traditional questionnaire. A gradient was also observed in the ratio of job counts in the traditional to icon-calendar questionnaire, starting at 100.0% in the most recent time period (1/1/94–interview 1) and decreasing to 0.0% in the earliest time period (before 1/1/84).

Amount of time accounted for was also much greater with the icon-calendar questionnaire than with the traditional questionnaire. This was true for both duration of work history and for percentage of time explained by employment (as opposed to unemployment or time unaccounted for) (Table III). The total number of work months accounted for in the icon-calendar questionnaire (160.3 [range: 1.9–370.7]) was much greater than in the traditional questionnaire (47.3 [0.1–190.9]). In each time period, significantly more work was reported using the icon-calendar questionnaire than using the traditional questionnaire, although the difference in the year of the first interview was relatively small (Fig. 2). In fact, while the percentage of time explained by employment remained relatively constant across time periods in the icon-calendar questionnaire, it decreased in the traditional questionnaire as one went further back in a subject's work history.

The percentage of missing time in the icon-calendar questionnaire was very low, never exceeding 2.4% in any time period (Table III). The percentage of missing time in the traditional questionnaire, on the other hand, was substantial, ranging between 22.1 and 100.0% in the most recent and most distant time periods, respectively.

Jobs in the icon-calendar questionnaire were more likely to have sufficient starting and ending date information (i.e., at least month and year) than those in the traditional questionnaire (data not shown). Only one subject (1.1%) was unable to provide starting and/or ending year for one or more jobs using the icon-calendar questionnaire, compared to 4.6% of subjects using the traditional questionnaire. With the icon-calendar questionnaire, one subject (the same as above) failed to provide starting and/or ending month for one or more jobs. With the traditional questionnaire, 55.2% of subjects were unable to fully provide this information, resulting in 12.5% of jobs missing one or both of these values.

Similar patterns were observed when analyses were restricted to *agricultural* job counts and durations (Table IV) and when analyses were stratified by gender.

The interviewer for Round 2 also interviewed 12 subjects in Round 1 (10 thinners and 2 referents). Subanalyses with only these 12 subjects show results

TABLE III. Work, Unemployment, Missing, and Total Months Accounted for in Both Questionnaires

	Work months		Missing months		Unemployment months[a]	Period total months[b]
	Median (range) Median % of period total[b]		Median (range) Median % of period total[b]		Median (range) Median % of period total[b]	Median (range)
Time period	Icon-calendar	Traditional	Icon-calendar	Traditional	Icon-calendar	
< 1/1/84[c]	92.8 (10.1–253.5)	0.0 (0.0–82.7)[f]	0.1 (0.0–122.4)	105.4 (0.0–263.7)[f]	0.0 (0.0–112.9)	107.6 (11.5–275.7)
	98.9	0.0	0.0	100.0	0.0	
1/1/84–12/31/88[d]	46.6 (0.0–60.0)	10.0 (0.0–60.0)[f]	1.4 (0.0–28.8)	42.8 (0.0–60.0)[f]	2.5 (0.0–60.0)	60.0 (5.0–60.0)
	86.9	18.3	2.4	81.7	4.2	
1/1/89–12/31/93[e]	49.9 (0.4–60.0)	32.1 (0.0–60.0)[f]	0.7 (0.0–29.6)	27.3 (0.0–60.0)[f]	7.4 (0.0–59.6)	60.0 (24.0–60.0)
	83.1	53.5	1.2	46.5	12.3	
1/1/94–interview1[e]	5.9 (0.1–7.6)	5.4 (0.0–7.6)[g]	0.0 (0.0–7.1)	1.5 (0.0–7.5)[f]	0.0 (0.0–7.0)	7.0 (6.3–7.6)
	86.3	77.9	0.0	22.1	0.0	
Total[e]	160.3 (1.9–370.7)	47.3 (0.1–190.9)[f]	3.8 (0.0–174.9)	145.6 (0.0–386.0)[f]	20.3 (0.0–201.1)	213.6 (31.2–403.2)
	87.1	24.7	2.0	75.3	9.9	

[a]Unemployment information collected only with the icon-calendar questionnaire.
[b]Period total was taken from the icon-calendar questionnaire (because it consistently provided the most complete time coverage) and was equal to the number of months in that time period except when a subject's work history began within that time period, in which case it was the number of months between the start of the subject's first reported job and the end of that time period.
[c]Both questionnaires: n = 70.
[d]Both questionnaires: n = 85.
[e]Both questionnaires: n = 89.
[f]$P < 0.001$.
[g]$P < 0.05$.

FIGURE 2. Percentage of time accounted for by each questionnaire.

similar to those obtained with the entire cohort, although with generally somewhat less discrepancy between the two questionnaires (data not shown).

DISCUSSION

The current study was designed to compare occupational histories collected via a traditional questionnaire with those collected using an icon/calendar-based questionnaire.

Using the icon-calendar questionnaire resulted in a far more detailed and full picture of a subject's occupational history than did the traditional questionnaire. Reporting of both the number of jobs and the amount of time employed in those jobs was much greater using the icon-calendar questionnaire. The discrepancy between the two questionnaires, which was generally quite small for the year of the first interview, increased the further back one went in a subject's work history.

Due to the complex and transient nature of migrant farm work, it was not possible to obtain records on a subject's actual work history. Thus, the present study could not validate the information provided in either questionnaire. Comparison of the two questionnaires addresses more the differences in quantity rather than quality of data

TABLE IV. Agricultural Job Counts and Work Months Accounted for in Both Questionnaires

	Number of agricultural jobs			Agricultural work months	
	Median (range) number of jobs		Median %	Median (range) Median % of period total[a]	
Time period	Icon-calendar	Traditional	Traditional/Icon-calendar[b]	Icon-calendar	Traditional
< 1/1/84[c]	3 (0–46)	0 (0–5)[f]	0.0	48.3 (0.0–218.8) 49.4	0.0 (0.0–82.7)[f] 0.0
1/1/84–12/31/88[d]	4 (0–34)	1 (0–13)[f]	20.8	21.1 (0.0–60.0) 38.9	2.9 (0.0–60.0)[f] 4.9
1/1/89–12/31/93[e]	6 (0–32)	2 (0–18)[f]	25.8	15.0 (0.0–60.0) 24.9	5.3 (0.0–60.0)[g] 8.9
1/1/94–interview 1[e]	1 (0–5)	1 (0–6)	100.0	1.0 (0.0–6.8) 14.0	0.9 (0.0–7.4) 13.1
Total[e]	15 (0–87)	5 (0–29)[f]	31.0	79.5 (0.0–331.2) 34.1	13.8 (0.0–190.9)[f] 8.5

[a] See footnote b in Table III.
[b] The median ratio of job counts in the traditional questionnaire to the icon-calendar questionnaire, in percent.
[c] Both questionnaires: n = 70.
[d] Both questionnaires: n = 85.
[e] Both questionnaires: n = 89.
[f] $P < .001$.
[g] $P < .05$.

collected, although the overall ''quality'' of a work history will be determined by both its accuracy and its completeness. While the completeness of reporting is addressed in this manuscript, we hope to address accuracy in future studies.

Subjects were much more patient and cooperative when being interviewed with the icon-calendar questionnaire than with the traditional questionnaire. As indicated previously, farm workers have very complex work histories involving frequent changes in employers, tasks, crops, and locations. Many farm workers are employed by two or more employers concurrently during busy agricultural periods. Using the traditional questionnaire, subjects appeared to have a great deal of difficulty recalling details of their lifetime employment, especially further back in time. When prodded for specifics, many grew frustrated and impatient. On the other hand, many subjects seemed to enjoy the process of the icon-calendar questionnaire, intrigued by seeing their ''lives'' literally drawn in front of them. It is likely that a cooperative and engaged subject will provide better information than one who is irritated and confused.

Additionally, subjects were often concerned about the accuracy of the completed calendar, making a great effort at the end to review and correct details, and to complete unaccounted for time periods. They often asked for a copy of the completed work-life calendar to take with them. Based on this behavior, we submit that the easily interpretable graphical portrayal of their personal and work lives elicited a commitment to accuracy and completeness on the part of the subject.

Life events calendars have been used in several studies to assist the recall of oral contraceptive use [Centers for Disease Control, 1983; Stadel et al., 1985; Centers for Disease Control and National Institute of Child Health and Human Development, 1986; van Leeuwen et al., 1992; White et al., 1994]. A validity study of self-reported oral contraceptive use utilizing this tool by van Leeuwen et al. [1992] found reasonably good agreement between subjects and prescribers. An Australian case-control study of sun exposure and skin cancer used calendars in which subjects recorded their residential and work histories for each year of life as the basis for a series of questions concerning personal sun exposure [Kricker et al., 1993]. However, differences in the nature of the exposures, subjects, and likely occupational histories between these studies and the present study make inferences difficult.

Differences in missing time between the two questionnaires are exaggerated by the fact that details on periods of unemployment were solicited and recorded in the icon-calendar questionnaire but not in the traditional questionnaire. Thus, ''missing'' time in the traditional questionnaire includes periods of unemployment which the subject might have reported if asked as well as time which might still have remained truly unaccounted for. However, the percentage of time accounted for by unemployment in the icon-calendar questionnaire is less than 10% and is much lower in most periods. This disparity in data collection methods is insufficient to account for the large disparity in reporting.

It is possible that differences in reporting between the two questionnaires are due to differences between the two interviewers. However, subanalyses of subjects interviewed by the same interviewer in both rounds give results similar to those observed for the entire cohort, suggesting that this is not an interviewer effect. Furthermore, results were generally similar in both questionnaires for the most recent time period but diverged with time, implying that the disparities are related to differences in recall between the two ascertainment methods.

Because the icon-calendar questionnaire was applied 8–10 months after the traditional questionnaire, it is possible that a subject's recall benefited from a ''booster effect'' as the subject remembered more details following their earlier reporting. Since this study did not employ a crossover design, such an effect would improve performance of the icon-calendar questionnaire only. However, results from the first round of a separate icon-calendar questionnaire reliability study—using different farmworker subjects but the same interviewer from the second round of the present study—are comparable to those of the second round of the present study (see accompanying paper by Engel et al.), suggesting that this effect does not account for the magnitude of difference observed between the two questionnaires.

Use of starting and/or ending dates imputed from the icon-calendar questionnaire data for jobs missing that information in the traditional questionnaire would tend to decrease differences in duration estimates between the two questionnaires. Thus, the true difference in performance between the two questionnaires is likely to be even greater than what is reported here.

One disadvantage of the icon-calendar questionnaire is the longer time needed to administer it. Collecting information on a subject's complete work history required approximately 1 h with the icon-calendar questionnaire vs. about 30 min with the traditional questionnaire. As in most research, there is a tradeoff between the time required to obtain information and the detail or quality of that information. However, depending on the uses of the data being collected, the time needed to administer this questionnaire could be shortened by reducing, as appropriate, the level of detail or the time period of interest.

With the traditional questionnaire, many subjects provided only a range of years when reporting seasonal jobs. This could potentially result in an overestimate of cumulative time spent in a job if, in fact, that job was not performed for one or more seasons during the specified time period. While this same error is possible using the icon-calendar questionnaire, a subject is more likely to recognize

it when literally viewing work periods juxtaposed to important life events and other employment. Thus, the icon-calendar questionnaire can help a subject to not only remember when they *were* engaged in certain employment but also when they were *not* engaged in that employment.

In conclusion, occupational histories obtained via the icon-calendar questionnaire were much more detailed and full—in terms of both number of jobs and amount of time accounted for—than those obtained via a traditional questionnaire. We believe that this was due to the more visual and engaging nature of this method. This questionnaire has particular application among populations with complex work histories and limited literacy, especially when collecting information from the more distant past.

ACKNOWLEDGMENTS

The authors thank the examiners/interviewers, Marni Aaron, Mirna Kunkel, Kerry Madland, and Emma Moreno. Thanks are also due to the Wenatchee area growers who allowed us access to their workers and to the Wenatchee area manufacturers who provided us with the opportunity to recruit among their workers.

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